

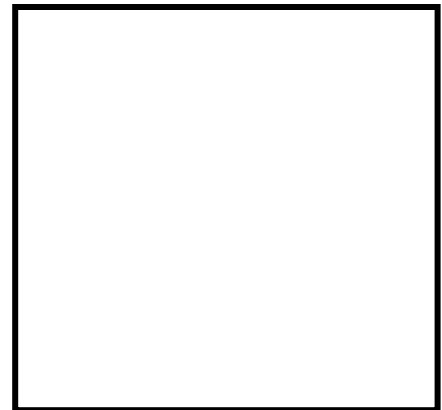
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**The worksheets listed above, or equivalent information, are required to be prepared for use with each project.**

All constructions or installations shall be supervised by a Wisconsin registered architect or engineer under section SPS 361.50, except that a Wisconsin registered HVAC designer may supervise the installation of heating, ventilating and air conditioning systems. The plans, specifications, worksheets and calculations require the signature and seal or stamp of an appropriate professional listed above per SPS 361.31(1).

Seal & signature is required at right, unless exempt by SPS 361.30(1).





**INSTRUCTIONS FOR:  
GRADE PLANE DETERMINATION WORKSHEET**

Three factors are required to determine the grade plane location of the building or facility. The factors are indicated in the worksheet Table as wall designation, wall length, and wall area. Two important pieces of information are provided from this worksheet, first being location of grade plane and second the building height.

Grade plane is defined in section 502.1 of the IBC as a reference plane representing the average of finished ground level adjoining the building at exterior walls. Where the finished ground slopes away from the exterior walls;

- The reference plane is established by the lowest points within the area between the building and the lot line, or
- Where the lot line is more than 6 feet from the building; the reference plane is established by the lowest points within the area between the building and such point 6 feet from the building.

The first column in the worksheet table is titled "wall designation" and is used to reference the individual wall being considered. All exterior walls of the building must be entered with a wall designation and must be accounted for within the table.

The second column is titled "wall length" and is the length of the wall being considered. Lengths of all walls need to be entered in the table. The wall lengths entered in this column are to be added giving us the total perimeter of the building. This value needs to be entered on the worksheet, designated as:

"Total of all wall lengths (building perimeter) =  Feet". Enter value here

The final column is titled "wall area" and is the actual area, above ground level, of the wall being considered. Please note that when the finished ground slopes away from the exterior wall, the calculated wall area shall also include the area of the wall below grade to lowest points within the area between the building and a point 6 feet from the building. Please also note that wall area could also include portions of roofs as illustrated in example # 2. The wall areas entered in this column are to be added and this value is to be entered on the worksheet in the area designated as:

"Total of all wall areas from above table =  Square feet" Enter value here

The value of Y (distance from roof to grade plane elevation or distance from a reference plane to the grade plane elevation) is obtained by dividing the total wall area above ground level by the perimeter (sum of wall lengths) of the building.

Building height is defined in section 502.1 of the IBC as the vertical distance from grade plane to the average height of the highest roof surface. Building height is the distance from the top of the building to the grade plane location. It should be noted that when doing the calculation for grade plane any reference plane could be used to perform the wall area calculation. When determining the building height when we use a reference plane, other than the top of the building, we must add the distance from the reference plane to the top of the building to the distance from the reference plane to the grade plane. By using a reference plane in some instances makes the arithmetic simpler in performing the calculations.

The final step to be completed on this worksheet is to determine the allowable building height above grade plane that is permitted by Table 503 of the IBC. The allowable building height indicated in Table 503 is based on occupancy groups and type of construction being utilized. Section 504 of the IBC does allow the building height specified in the table to be increased by 20 feet for some occupancies when a complete automatic fire sprinkler system is being provided. The allowable building height based on Table 503 with any associated modifications from section 504 must be greater than or equal to the building height "Y" calculated above.



## INSTRUCTIONS FOR:

### DETERMINATION OF NUMBER OF STORIES ABOVE GRADE PLANE

There are several factors that are required to determine the number of stories above grade plane. The first item that needs to be provided on this worksheet is building height Y as determined from the grade plane determination worksheet.

"Building height Y (from grade plane determination worksheet) =  feet"

Value of Y is entered on the worksheet here

The grade plane elevation is the roof elevation minus the building height Y. This step provides the elevation of the grade plane in relation to all other floor levels of the building and allows direct comparisons to the other floor levels.

"Grade plane elevation =  feet"

Grade plane elevation is entered on the worksheet here

The lowest ground level elevation also has to be provided on this worksheet. The lowest ground level elevation is the lowest elevation of the ground surface at any point along the perimeter of the building.

"Lowest ground level elevation =  feet"

Lowest ground level elevation is entered on the worksheet here

The first column in the worksheet table is titled floor level designation and is used to reference the individual floors being considered. All floor levels of the building must be entered with a floor level designation and must be accounted for within the table. Roofs must also be entered as a floor designation if such roof is to be occupied. Please note that floor levels satisfying the requirements of mezzanines and penthouses do not need to be entered as floor levels.

The second column is titled floor level elevation and is the elevation of the floor level within column 1 being considered. Elevations of all floor levels need to be provided within the table. Roof elevations must also be entered under this column as a floor elevation if the roof level is occupied.

The third column is titled story above grade and a yes or no response is to be required for all floor levels. If the floor level elevation listed in column 2 is equal to or higher than the grade plane elevation then a **yes** response must be provided and the floor level being considered is a story above grade. If a yes response is provided within column 3 there is no need to provide the information for columns 4, 5, and 6 for that particular floor level being considered.

If the floor level elevation in column 2 is lower than the grade plane elevation then a **no** response must be provided in column 3. If a **no** response is provided in column 3, the floor level being considered may still be considered a story above grade plane and the remainder of the information within the table (columns 4, 5, and 6) must be provided. In order to determine if the

floor level being considered is a story above grade plane, completion of the remaining portions of the worksheet table for such level being considered must be completed.

The remaining portions of the table (columns 4, 5, and 6) determines if floor levels with a floor level elevation lower than the grade plane are to be considered as basements or stories above grade plane. A basement is defined in section 502.1 of the IBC as that portion of a building partly or completely below grade plane. A basement is considered as a story above grade plane when **the finished surface of the floor above the basement** is:

- More than 6 feet above grade plane,
- More than 6 feet above the finished ground level for more than 50 percent of the total building perimeter, or
- More than 12 feet above the finished ground level at any point.

**Note that it specifies " finished floor surface of the floor above the basement"**

The fourth column is titled finished floor elevation above > 6 feet above grade plane and a yes or no response is required. This column is comparing the elevation of the **finished surface of the floor above** to the location of the calculated grade plane. If the finished surface of the floor above is greater than 6 feet above the grade plane then a **yes** response must be provided and the floor level being considered would be a story above grade plane. If a yes response is provided within column 4 there is no need to provide the information for columns 5 and 6 for that particular floor level being considered. Information must be provided within this column for all floor areas that had a no response within column 3.

If the finished surface of the floor above is less than 6 feet above the grade plane then a **no** response must be provided in column 4. If a **no** response is provided in column 4, the floor level being considered may still be considered a story above grade plane and the remainder of the information within the table (columns 5, and 6) must be provided. In order to determine if the floor level being considered is a story above grade plane, completion of the remaining portions of the worksheet table for such level being considered must be completed.

The fifth column is titled 50 % or more of floor level above > 6 feet above ground level and a yes or no response is required. This column is indicating if the percent of **finished surface of the floor above**, that is more than 6 feet above the location of the finished ground level for the entire building perimeter is greater than 50 %. If the finished surface of the floor above is greater than 6 feet above the finished ground level for more than 50 % of the building perimeter then a **yes** response must be provided and the floor level being considered would be a story above grade plane. If a yes response is provided within column 5 there is no need to provide the information for column 6 for the particular floor level being considered. Information must be provided within this column for all floor areas that had a no response within columns 3 and 4.

If the finished surface of the floor above is greater than 6 feet above the finished ground level for less than 50 % of the building perimeter then a **no** response must be provided in column 5. The floor level being considered may still be considered a story above grade plane and the information within column 6 must be provided.

The final column is titled finished floor level above > 12 feet above finished ground level and a yes or no response is required. This column indicates if any portion of the finished surface of the floor above is more than 12 feet above the finished ground level at any point. If the finished surface of the floor above is greater than 12 feet above the finished ground level at any point then a **yes** response must be provided and the floor level being considered would be a story above grade plane. Information must be provided within this column for all floor areas that had a no response within columns 3, 4, and 5.

If the finished surface of the floor above is less than 12 feet above the finished ground level at any point then a **no** response must be provided and the floor level being considered would not be a story above grade plane. If a no response is within columns 3, 4, 5, and 6 the floor level being considered would be a basement floor level and is not counted as being a floor level above grade plane.

When the information is provided for all floor levels of the building the total number of floor levels above grade plane is determined by counting the number of yes responses within columns 3, 4, 5, and 6. Please note that if we have a yes response provided in more than one column for a particular floor level being considered only one of the yes responses is counted. The total number of floor levels is then entered on the worksheet as shown below:

*"Stories above grade = (# of yes responses in column 3) + (# of yes responses in column 4) + (# of yes responses in column 5) + (# of yes responses in column 6) =  stories"*

Enter value here

The final step to be completed on this worksheet is to determine the allowable number of stories above grade plane that is permitted by Table 503 of the IBC. The allowable number of stories indicated in Table 503 are based on occupancy groups and type of construction being utilized. Section 504 does allow the number of stories specified in the table to be increased by one for some occupancies when a complete automatic fire sprinkler system is being provided. The allowable number of stories based on Table 503 with any associated modifications from section 504 must be greater than or equal to the number of "stories above grade" as calculated above.

*"Permitted number of stories from Table 503 including any modifications to the number of stories from IBC section 504 =  stories"*

Enter value here

## OCCUPANT LOAD WORKSHEET

1	2	3	4	5	6	7	8	9
ROOM OR SPACE DESIGNATION	CLASSIFICATION OF Table 1004.1.1 OCCUPANCY OR USE	FLOOR AREA (square feet)	DENSITY SF/PERSON (specify if net or gross value)	OCCUPANT LOAD BY CALCULATION	OCCUPANT LOAD BY ACTUAL NUMBER	OCCUPANT LOAD BY COMBINATION	ROOM OR SPACE TOTAL	OCCUPANTS ACCOUNTED FOR IN OTHER SPACES

**The total occupant load for this worksheet page (or story of the building) = \_\_\_\_\_ Occupants**

**The total occupant load for this building = \_\_\_\_\_ Occupants** *(total of all worksheets/stories)*

*Caution: Note that this form is not adequate for use of covered mall total occupant calculations.*



## WORKSHEET INSTRUCTIONS

Design occupant load as determined by IBC 1004 requires that either Table 1004.1.1 be used, or that the subsections under 1004 be referenced. IBC 1004.2 does allow for increased occupant loads when all other requirements of the code are also met based on such a modified number. An alternative occupant load determination with justification that is deemed reasonable to the Dept. may also be used. This Worksheet (partial shown below) can be used to show the requirement for each space.

The first five columns are used to show the IBC 1004.1.1 procedure, sometimes referenced as the calculation method. The next column is used for actual numbers either by fixed seats or posting of capacity. The seventh column is for the procedure where occupants may be in more than one space, but each space may be separately or simultaneously occupied.

### OCCUPANT LOAD WORKSHEET

Column omitted because of space

1	2	3	4	5	6	7	8
ROOM OR SPACE DESIGNATION	CLASSIFICATION OF Table 1004.1.1 OCCUPANCY OR USE	FLOOR AREA (square feet)	DENSITY SF/PERSON (specify if net or gross value)	OCCUPANT LOAD BY CALCULATION	OCCUPANT LOAD BY ACTUAL NUMBER	OCCUPANT LOAD BY COMBINATION	ROOM OR SPACE TOTAL

In the ROOM OR SPACE DESIGNATION (first) column above, the name or number of a room or space is noted. When rooms have the same use, they may be designated together as one entry.

CLASSIFICATION OF OCCUPANCY OR USE (second) column would have an entry of what the space will be used for (i.e., the function of the space). This may be matched with the use in the first column of IBC Table 1004.1.1, which is labeled as OCCUPANCY. Where function of the space does not match the table, then use the most similar to that actually shown in the table.

FLOOR AREA (third) column above is where an actual square foot area from the plan is entered for the location described in the first column. Please note that IBC Table 1004.1.1 requires net floor area for some occupancies and gross floor area for others. See the next column (density) for direction on which to use. The correct area amount of each occupancy must be carefully entered.

DENSITY (fourth) column is a number taken directly from IBC Table 1004.1.1 as the floor area in square feet per occupant. The table will specify either **gross** area or **net** area for each occupancy type. Table 1004.1.1 has a short list of different occupancy choices. These are not the same as the long description lists in Chapter 3 occupancy definitions or long list for the floor loads in Chapter 16 of the IBC or even the many occupancies for ventilation classes in IMC Table 403.3 (which has different, but similar occupant densities). Thus you must choose the occupancy from IBC Table 1004.1.1 which most closely resembles how the space is to be used. This may have an effect on how carefully the intended use of each space will have to be labeled on the plans (for example *assembly without fixed seats* has 3 different density entries).

OCCUPANT LOAD BY CALCULATION (fifth) column above is simply the resultant of the floor area in column three divided by the occupant density in column four. Often this will also be the number in column eight, but not always. One of the next two columns may have a higher occupant number; thus fifth column result will not be used in column eight for a total occupancy.

## WORKSHEET INSTRUCTIONS (continued)

OCCUPANT LOAD BY ACTUAL NUMBER (sixth) column is when IBC Section 1004.1.1 would have the actual number of people designated. This is always used for assembly fixed seating, because the actual quantity of occupants is always known as the number of seats shown on the plans. Or it may be when an owner designates a higher occupant load for a space than is normally expected for that use. It may also be done where plans show a space that has multiple uses; one of which may exceed an occupant total as calculated per Table 1004.1.1 requirement.

OCCUPANT LOAD BY COMBINATION (seventh) column will be used when the number by combination IBC Section 1004.1 includes in the primary space the number of the sum of persons in the primary space plus persons egressing from accessory spaces through the primary space. Note that in the ninth column for Occupants Accounted For In Other Spaces you must indicate a “YES” for the accessory space when this seventh column is used.

ROOM OR SPACE TOTAL (eighth) column is the largest value of columns five, six, and seven. This will be used to apply the egress criteria (number, width, swing direction, and location of doors) for that room or space in question.

OCCUPANTS ACCOUNTED FOR IN OTHER SPACES (ninth) column is usually used for a space which is accessory to another occupancy and occupants egress through that primary space. The **yes** answer in this column is used in the case of IBC Section 1004.1 where occupant load by combination in the seventh column shows an entry for the primary space. It may also be used when a non-simultaneous use of the space has been documented and approved by a code official. The space that is accessory to the primary space would have a “yes” marked in this column, but the primary space would remain blank in this column. The response in this column is always assumed no, unless the yes appears. This column is an important marker used when calculating the total building occupant load, so that these accessory areas are not counted twice.

The total occupant load for this page (or story of the building) =  Occupants Page total here

**The total occupant load for this building = \_\_\_\_\_ Occupants** (*total of all worksheets/stories*)

Total occupant load lines at the bottom of the worksheet (reprinted above) are first for the total for *that worksheet*. The last line is for the total of all worksheets, when more than one worksheet is needed. The total is the addition of total for each room or space shown in the TOTAL (eighth) column, except without adding the spaces by combination. Remember to count occupants of any rooms that are by combination only once, as these should be marked “yes” in the final column.

Multi-story buildings are encouraged to use a separate worksheet for each story, as it will then be easier to verify exit width of stairways and other egress components for that floor and for each space within that floor. The building occupant total would be used to verify egress requirements for the building as a whole and to determine requirements for sanitary fixtures in the building.



## ASSEMBLY EGRESS WIDTH SUB-WORKSHEET

Is the occupant load of a Group A occupancy over 300 persons? \_\_\_\_ (Yes or No) If yes, see Section 1028.2

Is the assembly seating area smoke-protected? \_\_\_\_ (Yes or No)

If **yes**, then an evaluation per NFPA 101 shall be submitted with the plans and the egress widths shall be based on IBC Table 1028.6.2 minimums. All of the requirements of Sections 1028.6.2.1, 1028.6.2.2, and 1028.6.2.3 must be met, or else it is not smoke-protected seating.

If **no**, then use the following requirements from Section 1028.6.1 as listed below.

Clear width of aisles and other means of egress for non-smoke-protected seating shall be per cases 1 through 6 below. (*Indicate which formula is being used.*)

Where **W** = Required width in **inches per occupant**  
**R** = Riser height in inches (from tread to tread)

Case 1 – Where  $R \leq 7.0''$  Then  $W = 0.3$  (Formula 10-1)

Case 2 – Where  $R > 7.0''$  Then  $W = 0.3 + 10(R - 7.0'')(0.005)$  (Formula 10-2)

Case 3 – Where egress requires stair descent without a handrail within a horizontal distance of 30'' and  $R \leq 7.0''$ , then add 0.075'' additional width per occupant  
Then  $W = 0.375 = 0.3 + 0.075$  (Formula 10-3)

Case 4 – Where egress requires stair descent without a handrail within a horizontal distance of 30'' and  $R > 7.0''$ , then add the 0.075'' additional width per occupant plus a factor  
Then  $W = 0.375 + 10(R - 7.0'')(0.005)$  (Formula 10-4)

Case 5 – Where ramped means of egress > 1:12 slope Then  $W = 0.22$  (Formula 10-5)

Case 6 – Where level or ramped means of egress  $\leq$  1:12 slope Then  $W = 0.20$  (Formula 10-6)

Note that for outdoor smoke-protected assembly seating, the width may meet the lesser of clear width of Section 1008.5.3 or the Table 1008.5.2 requirement serving the same number of seats.

Case 7 – Where outdoor smoke-protected seating using stairs Then  $W = 0.08$  (Formula 10-7)

Case 8 – Where outdoor smoke-protected seating using ramps, corridors, tunnels or vomitories  
Then  $W = 0.06$  (Formula 10-8)

**NOTE THAT MINIMUM AISLE WIDTHS PER SECTIONS 1028.9.1, 1028.9.2, 1028.9.3, AND 1028.9.4 MUST ALSO ALWAYS BE PROVIDED. These widths include:**

42'' aisle for level or ramp with seats both sides	48'' for aisle stairs with seats on both sides
36'' aisle for level or ramp with seats on both sides if under 50 seats	36'' aisle stair w/seats both sides if < 50 seats
36'' aisle for level or ramp with seats one side	36'' for aisle stairs with seats one side
23'' clear to handrail serving aisle stair less than 5 rows on one side	23'' clear to handrail dividing an aisle stair

## WORKSHEET INSTRUCTIONS

ROOM OR SPACE DESIGNATION	OCCUPANCY OR USE CLASSIFICATION	OCCUPANT LOAD FROM WORKSHEET	STAIR WIDTH FACTOR	REQUIRED STAIRWAY WIDTH	OTHER EGRESS COMPONENT FACTOR	OTHER EGRESS COMPONENT WIDTH

In the ROOM OR SPACE DESIGNATION (first) column above, the name or number of a room or space is noted. When adjacent rooms on a floor level have the same use, they may be designated together as one entry. This may be the same as listed in the Occupant Load Worksheet or a part of the space listed in that worksheet, when separate spaces or rooms are within a designated area.

OCCUPANCY OR USE CLASSIFICATION (second) column would have an entry of what the space will be used for, the function of the space. This may be matched with the use in the first column of IBC Table 1004.1.1, which is labeled as OCCUPANCY. Where function of the space does not match the table, then use the most similar to that actually is shown in the table.

OCCUPANT LOAD FROM WORKSHEET (third) column above is simply the room or space total as taken from the eighth column of the Occupant Load Worksheet. If that Worksheet has not yet been completed, you will have to at least complete the calculations that would be required by that sheet to obtain a number for this column.

STAIR WIDTH FACTOR (fourth) column is the value taken from IBC Table 1004.1.1 for the occupancy (and complete sprinkler system or not provided) being exited. Assembly seating facilities are the only exception to this, as IBC Table 1028.6.2 aisle stairs have a different factor.

REQUIRED STAIRWAY WIDTH (fifth) column is *at least* the product of the occupant load (third column) times the width factor (fourth column). Minimum width requirements shall be met for each stair. Requirement of IBC Section 1009.1 is usually 44" minimum (exceptions may apply). Per IBC Section 1007.3 for accessible means of egress serving an area of refuge provide a minimum of 48" between handrails or by IBC Section 1028.9.1 for Assembly aisle stair usually 48" for seating both sides or 36" on one side is needed (with some exceptions).

OTHER EGRESS COMPONENT FACTOR (sixth) column is the factor, used for paths such as corridors, ramps, and doorways, taken from IBC Table 1005.1 for the occupancy being exited (and complete sprinkler system or not provided). Assembly seating facilities are the only exception to this, as IBC Table 1028.6.2 passageways and ramps have a different factor.

OTHER EGRESS COMPONENT WIDTH (seventh) column is *at least* the product of the other egress component factor (seventh column) times the occupant load (third column). Minimum width requirements shall be met for each doorway, ramp or corridors as required by other parts of IBC Chapter 10.

Please see the examples showing the use of this worksheet on the following pages.

## **MULTIPLE OCCUPANCIES WORKSHEET**

- I am using non-separated uses in my design. (IBC 508.4)
- I am using separated uses in my design. (IBC 508.3)
- I am using a combination of separated and non-separated uses in my design.

### **SEPARATED USES**

<b>LOCATION</b> (story or side of building)	<b>OCCUPANCIES SEPARATED</b> (both classifications)	<b>FIRE RATING</b> (hourly rating)
<i>(sample) east third floor</i> _____	<i>office B and lunchroom A-2</i> _____	<i>2 hours</i> _____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

### **NON-SEPARATED USES**

<b>LOCATION</b> (story or side of building)	<b>OCCUPANCIES NOT SEPARATED</b> (all classifications)	<b>CONSTRUCTION TYPE</b> ____ <b>MOST RESTRICTIVE</b>
<i>(sample) east third floor</i> _____	<i>office B and lunchroom A-2</i> _____	<i>A-2</i> _____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Go to Allowable Areas Worksheets to verify building size allowable for uses shown above.

## WORKSHEET INSTRUCTIONS

*This worksheet is only required when there is more than one occupancy group in a building. Selection of your first choice below is key to checking compliance with area limitations and requirements related to fire-resistance ratings needed or not needed between different occupancy groups in the building. Note that accessory use areas and firewall separations to create separate buildings are not addressed here.*

### MULTIPLE OCCUPANCIES WORKSHEET

- I am using non-separated uses in my design. (IBC 508.3)
- I am using separated uses in my design. (IBC 508.4)
- I am using a combination of separated and non-separated uses in my design.

**Check only one of the three boxes to tell the code officials the intent of your design.**

*The review of plans and inspection of the building will have different lines of thought process and follow different assumptions, depending on which of the three above options is chosen. Thus this is critical information to know at the start of a plan review or before walking into a building on the site.*

*The next part of this worksheet, shown below, is used if the first or third option is chosen.*

#### SEPARATED USES

<b>LOCATION</b> (story or side of building)	<b>OCCUPANCIES SEPARATED</b> (both classifications)	<b>FIRE RATING</b> (hourly rating)
<u>(sample) east third floor</u>	<u>office B and lunchroom A-2</u>	<u>2 hour wall</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

*The next part of this worksheet, shown below, is used if the second or third option is chosen.*

*Note that you **must** fill in the type of construction to determine most restrictive occupancy.*

#### NON-SEPARATED USES

<b>LOCATION</b> (story or side of building)	<b>OCCUPANCIES NOT SEPARATED</b> (all classifications)	<b>CONSTRUCTION TYPE</b> <b>MOST RESTRICTIVE</b>
<u>(sample) east third floor</u>	<u>office B and lunchroom A-2</u>	<u>A-2</u>
_____	_____	_____
_____	_____	_____

*Note the above column for “most restrictive” of the two occupancies is which ever has the most restrictive area or height using that construction type (also critical to know) listed above.*

Go to Allowable Areas Worksheets to verify building size allowable for uses shown above.

*While this worksheet can stand alone, it usually will require Allowable Areas Worksheets to verify design.*



## WORKSHEET INSTRUCTIONS

### MULTIPLE OCCUPANCIES WORKSHEET

- I am using non-separated uses in my design. (IBC 508.3)
- I am using separated uses in my design. (IBC 508.4)
- I am using a combination of separated and non-separated uses in my design.

#### SEPARATED USES

<b>LOCATION</b> (story or side of building)	<b>OCCUPANCIES SEPARATED</b> (both classifications)	<b>FIRE RATING</b> (hourly rating)
(sample) east third floor _____	office B and lunchroom A-2 _____	2 hours _____
_____	_____	_____
_____	_____	_____
_____	_____	_____

*Note that the top half of the worksheet is left blank, as no separated uses are being provided in the design.*

*On the top of the next page of this example you will find the bottom half of the page, which is the part that must be completed for the non-separated uses to be clearly shown. You will note that not all of these separations are located on one specific floor level, thus the location must be clearly described.*

*If the third box (shown here below) is checked, then fill out both parts, as both are applicable.*

- I am using a combination of separated and non-separated uses in my design.

*As a result of non-separated uses, care must be exercised in filling in the proper allowable area for the non-separated uses in the allowable areas worksheet, as the more restrictive area limit will apply to both of the non-separated occupancies. See examples of that on those worksheets.*

Go to **Allowable Areas Worksheets** to verify building size allowable for uses shown above.

## ALLOWABLE AREAS WORKSHEET

### AREA MODIFICATIONS TO TABLE 503

Allowable area = Tabular area + Frontage increase + Sprinkler increase

$$A_a = A_t + [(A_t)(I_f)/100] + [(A_t)(I_s)/100] = \underline{\hspace{10em}}$$

$A_a$  = Allowable area per floor

$A_t$  = Table 503 area per floor

$I_f$  = Area increase due to frontages =  $(100)[F/P - 0.25](W/30)$

$I_s$  = Area increase due to complete sprinkler protection (NFPA 13)

F = Building perimeter which fronts an open space having a minimum width of 20 feet

P = Perimeter of the entire building

W = Minimum width of open space for frontage exposure on any side

### Sprinkler increase

$I_s$  = Sprinkler increase for one-story buildings = 300 percent

$I_s$  = Sprinkler increase for multi-story buildings = 200 percent

$I_s$  = Building not completely sprinkler protected = 0 percent

**Frontage calculation** (note that frontage is only permitted on open space that is a public way or space that is a minimum 20 feet wide which is accessed from a street or fire lane)

Building frontage lengths	_____	_____	_____	_____
	North wall	East wall	South wall	West wall
Minimum width of open space	_____	_____	_____	_____

Minimum width of open space (W) = \_\_\_\_\_ (least of above  $\geq$  20 feet)

Total building frontage (F) = \_\_\_\_\_ (total of above four frontages)

Total building perimeter (P) = \_\_\_\_\_ (total of four building sides)

Area increase due to frontages  $I_f = (100)[F/P - 0.25](W/30) = \underline{\hspace{10em}}$



## WORKSHEET INSTRUCTIONS

*This worksheet is only needed if there is more actual building area than the value shown in Table 503.*

### ALLOWABLE AREAS WORKSHEET

#### AREA MODIFICATIONS TO TABLE 503

**A<sub>a</sub> = Allowable area per floor = A<sub>t</sub> + [(A<sub>t</sub>)(I<sub>f</sub>)/100] + [(A<sub>t</sub>)(I<sub>s</sub>)/100] = \_\_\_\_\_**

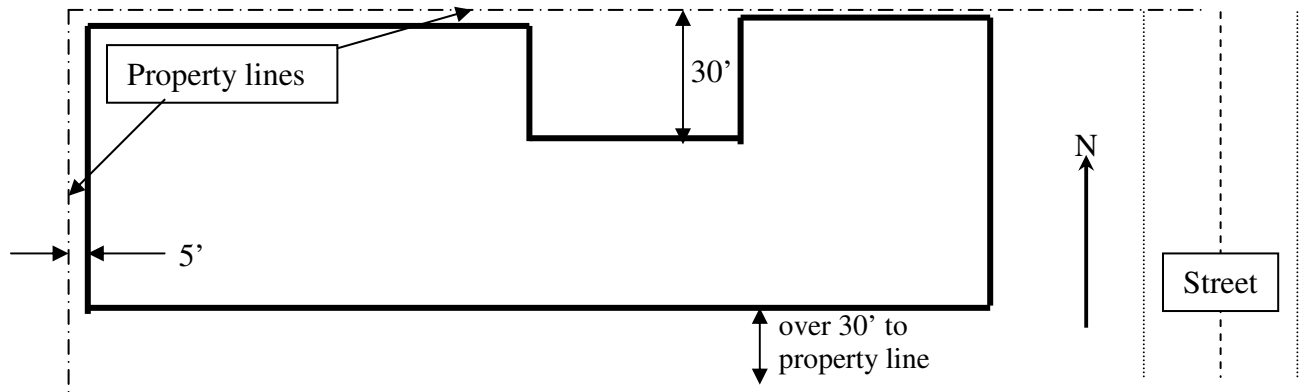
*Base value of table area is always permitted (thus A<sub>t</sub>). The second part of the equation is the frontage increase [(A<sub>t</sub>)(I<sub>f</sub>)/100]. The third part of the equation is sprinkler increase [(A<sub>t</sub>)(I<sub>s</sub>)/100].*

**A<sub>t</sub> = Table 503 area per floor** for the occupancy group and type of construction of the building.  
*If more than one occupancy group, use the most restrictive of non-separated uses shown.*

**I<sub>f</sub> = Area increase due to frontages = (100)[F/P – 0.25](W/30)**

*Maximum increase due to frontages is 75%; this is when the full perimeter has at least 30' open space.*

**F = Frontage** of a building perimeter which fronts an open space having a minimum width of 20 feet, the open space could be a public way or could be a yard on the property that leads to a street or approved fire lane (see COMM 62.0500 for fire apparatus access requirements). If a 20 foot or more wide yard is provided, but no access to that yard by fire-fighting equipment is provided, then no credit can be taken for that portion of the perimeter (see this example of this below).



*In the above example only the south and east frontage areas can be used to calculate an area increase, as even though the north wall has some area with over 20 feet of open space, it does not have fire access to that open space.*

**P = Perimeter** of the building measured at exterior walls of entire building or measured per IBC 503.1 at exterior walls and fire walls (used to create separate buildings for area limitations). If a fire wall is used to create separate buildings, the fire wall length is counted along with the other exterior walls.

**W = Width** of open space for frontage exposure on any side. Minimum width to be counted is 20 feet. Maximum permitted width counted is 30 feet. The side with the smallest W is used in the calculation.

**I<sub>s</sub> = Area increase due to complete sprinkler protection** *This is either 200% or 300% or 0.* Sprinkler increase is only permitted for complete sprinkler system per Section 903.3.1.1 (NFPA 13) in the building. Sprinkler increase for one-story buildings is 300 percent, increase for multi-story buildings is 200 percent.

## WORKSHEET INSTRUCTIONS

### ALLOWABLE AREAS WORKSHEET

Provide only one story per worksheet; use a separate worksheet page for additional stories as necessary. Provide the information in first through fourth columns for each occupancy (see the examples on pages following). Then enter in fifth column the allowable area as modified by the equation from the previous part of this two-page worksheet. Then divide third column by fifth column and put answer in sixth column.

<b>STORY LOCATION</b>	<b>USE GROUP</b>	<b>ACTUAL FLOOR AREA</b>	<b>TABLE 503 AREA</b>	<b>MODIFIED AREA ALLOWABLE</b>	<b>RATIO Actual/Allowable</b>

**TOTAL OF ALL RATIOS =**  **Must be ≤ 1.0**

Add the sum of all of the ratios in the sixth column and place the total in this location. The story passes area requirement if the total is 1.0 or less, it fails area limit if it exceeds 1.0 total value here.

A check below is preformed once for the entire building, if using multiple sheets; you only need do it once.

**MAXIMUM AREA DETERMINATION OF BUILDING** (check only required if > 3 stories)

Total floor area of the building (all stories) = \_\_\_\_\_ (the actual building total square feet)

Largest value of allowable area (any story) = \_\_\_\_\_ (highest value in any above column 5)

Allowable floor area of building (IBC 503.1) = \_\_\_\_\_

Is actual total area less than maximum allowable area? \_\_\_\_\_ [Answer **no** if allowable (third entry) exceeds actual (first entry) and answer **yes** if allowable (third entry) exceeds actual total (first entry).]



**INSTRUCTIONS FOR:  
EXTERIOR WALL OPENING WORKSHEET**

There are several factors that are required to determine compliance for exterior wall openings. Please note that the exterior opening requirements are to be done on a per floor level basis.

The first column within the worksheet table is titled "wall designation" and is used to reference the exterior wall being considered. Within this column, information on all of the exterior walls for each floor level of the building can be provided or only the worst case scenario can be provided for each side of the building. It should be noted that for some buildings, the wall areas for differing sides of the building that would be considered the most restrictive could be located on different floor levels. For example, the worst case for a west wall may be the second floor wall area while on the north face the worst case may be the third floor wall area. For such example the worksheet needs only to include the worst case scenario for each wall face and does not have to be completed for all the wall faces of each floor.

The second column is titled "wall area" and is the exterior wall area of the wall designation that is being considered. Since the requirements for exterior wall openings are to be done on a per floor level basis, the associated wall area is also to be on a per floor level basis. The definition of story in section 202 of the IBC is **that portion of a building included between the upper surface of a floor and the upper surface of the floor or roof above**. The associated wall area for the exterior wall for the wall designation being considered then should be the horizontal dimension of the exterior wall multiplied by the height of the story, as defined above and in section 202 of the IBC. Wall areas must be provided within the table for all wall designations being provided.

The third column is titled "fire separation distance". Section SPS 362.0702 provides the definition for fire separation distance. Fire separation distance is the distance measured from the building face to the closest interior lot line, to a centerline of a street, alley or public way, to a permanent no-build easement line, or to an imaginary line between two buildings on the same property. Fire separation distances are measured at right angles from the lot line. Fire separation distances must be provided within the table for all of the wall designations that are being considered.

The fourth column is titled "area of unprotected openings ( $A_u$ )". It is the area of all openings in the exterior wall that do not have a fire resistance rating for the wall designation being considered. If openings are provided that have a fire resistance rating, the areas of such openings are not to be included in this column, but should be included within column 5. The area of all unprotected openings for the wall designation being considered must be provided within the table.

*Please note that for determining opening areas, both protected and unprotected, the opening area is calculated as the area from jamb to jamb in the vertical and horizontal directions of the opening.*

The fifth column is titled "area of protected openings (A)". It is the area of all openings in the exterior wall that have a fire resistance rating for the wall designation being considered. If openings are provided that do not have a fire resistance rating, the areas of such openings are not to be included in this column, but should be included within column 4. The area of all protected openings for the wall designation being considered must be provided within the table.

*Please refer to section 715 of the IBC for specific requirements for opening protectives. Such section provides the requirements for when door and window openings are considered protected.*

The sixth column is titled "% factor from Table 705.8 for unprotected openings" and the value of such is obtained from Table 705.8 of the IBC. The percentage of unprotected openings within Table 705.8 is

based on the fire separation distance associated with the wall designation being considered. The footnotes under Table 705.8 should also be referred to when using such table. The percentage value for unprotected openings must be provided on the worksheet for the wall designation being considered.

The seventh column is titled "allowable area of unprotected openings ( $a_u$ )" and is the maximum allowable area of unprotected openings permitted by section 705.8. The allowable area of unprotected openings ( $a_u$ ) is obtained by multiplying the wall area (column 2) by the % factor from Table 705.8 for unprotected openings (column 6). The allowable area of unprotected openings ( $a_u$ ) must be provided in the worksheet table for the wall designation being considered.

Column eight is titled "% factor from Table 705.8 for protected openings" and the value of such is obtained from Table 705.8 of the IBC. The percentage of protected openings within table 704.8 is based on the fire separation distance associated with the wall designation being considered. The footnotes under table 705.8 should also be referred to when using such table. The percentage value for protected openings must be provided on the worksheet for the wall designation being considered. Protected openings are openings that comply with the applicable requirements of section 715 of the IBC.

The ninth column is titled "allowable area of protected openings ( $a$ )" and is the maximum allowable area of protected openings permitted by section 705.8. The allowable area of protected openings ( $a$ ) is obtained by multiplying the wall area (column 2) by the % factor from Table 705.8 for protected openings (column 8). The allowable area of protected openings ( $a$ ) must be provided in the worksheet table for the wall designation being considered.

Column ten is titled "ratio of unprotected openings ( $A_u/a_u$ )". This is the check to ensure that the area of unprotected openings is not greater than the allowable area of unprotected openings for the wall designation (column 4 divided by column 7). The ratio of the area of unprotected openings to the area of the allowable unprotected opening must be less than 1.0. The ratio of unprotected openings must be provided in the table for the wall designation being considered.

Column eleven is titled "ratio of protected openings ( $A/a$ )". It is the check to ensure that the area of protected openings is not greater than the allowable area of protected openings for the wall designation (column 5 divided by column 9). The ratio of the area of protected openings to the area of the allowable protected openings must be less than 1.0. The ratio of protected openings must be provided in the table for the wall designation being considered.

The final column, twelve is titled "interaction check of ratios ( $A_u/a_u$ ) + ( $A/a$ )". This equation is the final check to ensure that the total area of all openings within the wall designation being considered is allowed. Section 705.8 of the IBC requires that a unity check be performed to verify that the total opening area of the unprotected and protected openings does not exceed 1.0. For all wall designations being considered the interaction check of the ratios must be provided.

If the interaction value is greater than 1.0, then the exterior wall openings for the wall designation being considered is in violation of section 705.8 of the IBC and the openings must be reduced in area until the interaction equation is equal or less than 1.0. One possible solution to obtain compliance without decreasing the amount of total openings would be to reduce the number of unprotected openings and increase the number of protected openings.

If the interaction value is equal or less than 1.0 then the exterior wall openings for the wall designation being considered is in compliance with section 705.8 and no modifications to the exterior wall openings need to be provided.





## SANITARY FIXTURE WORKSHEET INSTRUCTIONS

Total building design occupancy = \_\_\_\_\_ (determined from IBC 1004.1.1)

This number can be determined by occupant load worksheet. That worksheet should be completed first, then this worksheet can be filled in with the information from that sheet.

Building occupancy which most closely resembles the use of the space (list each separately)  
(Caution: Table 2902.1 uses may be more exact than general use groups of IBC chapter 3)

Note that the occupancy names used in Table 2902.1 and in Table 1004.1.1 may not match the general names for the occupancy found in IBC Chapter 3 or the specific label of a space on the plan set. The completion of the table below with the name of the occupancy and the factor for each fixture type will make it clear to plan examination staff how the design used was viewed in terms of grouping the occupancy. If a particular room on the plans has a designation that does not clearly match one of the occupancies found in Table 2902.1, then the occupancy closest to the use of that room should be utilized.

OCCUPANCY		WATER CLOSETS			LAVATORIES		TUB/SHOWER		DF	OTHER
Type	Number People	Factor	Fixtures # Male	Fixtures # Female	Factor	Number Fixtures	Factor	Number Fixtures	Number Fixtures	List the Type
Education	80	50	0.8	0.8	50	2	NA	0	1	Service sink
Museum	200	125/65	0.8	1.6	200	1	NA	0	1	Service sink

In the above table are two lines from the example on the next page. The first line shows numbers for a daycare space. Because there is no entry in Table 2902.1 labeled for daycare, the label and factors for Educational from Table 2902.1 are used. Number is the occupancy taken from Table 1003.2.2.2 for “Educational” sub-group “Classroom area”, as it best approximates the type and usage of daycare. Thus a 40’ x 40’ daycare divided by 20 SF/person is the 80 occupants for that space.

The next line shows the children’s museum entry as being under the assembly main heading in the third row of Table 2902.1 for Museums. The number is based on the “Assembly without fixed seats” and “Unconcentrated” sub-group, as this best describes the Children’s Museum assembly use of that space. The 60’ x 50’ museum space divided by 15 SF/person is the 200 occupants entered there.

*Under the next main column of “water closets” we see on the first line one water closet per 50 persons. As 50 does not evenly divide into 80 occupants (40 men and 40 women), the number of fixtures must be rounded upward to one decimal place for the fraction of the fixture. Also note that the second entry has two different numbers for the factor column. The first number is the requirement for male water closets and the second number for female water closets. In this case, the 200 persons are first divided into 100 males and 100 females, and then applied to the table. As 100 males are only a fraction of one fixture, list that fraction to one decimal place if sharing common toilet facilities or else the values is rounded-up to one if the space has it’s own toilet facilities. Similarly the 100 females are slightly over 1.5 fixtures; thus it is rounded-up to 1.6 water closets for the women. Note that when no varied male & female numbers are required by Table 2902.1, then the total is calculated and divided equally to each sex at that time. If a space has self-contained toilet fixtures, then round all fractions to the next (higher) whole number.*

*The other fixture types are calculated in a similar manner.*

**CONTROL AREA WORKSHEET:**

1) Will there be any hazardous materials stored or used within the building? \_\_\_\_\_ (YES or NO)  
If "**NO**" then the remainder of the worksheet does not have to be completed.

If "**YES**" proceed to question 2.

2) Will this building be designed as a Group H occupancy? \_\_\_\_\_ (YES or NO)  
If "**NO**" then the remainder of the worksheet starting at question 3 must be completed.

If "**YES**", complete the "Control Area Sub-worksheet" and answer question 2a. The completion of the remainder of the worksheet is not required.

2a) Are the quantities of hazardous materials provided within column 6 of the Control Area Sub-worksheet greater than the quantities permitted in Tables 307.1(1) or 307.1(2) shown in column 7 of the Control Area Sub-worksheet? \_\_\_\_\_ (YES, NO OR N/A)

3) Will this building be divided into control areas? \_\_\_\_\_ (YES or NO)  
If "**YES**" complete the "Control Area Table" and the "Control Area Sub-worksheet".

If "**NO**", complete the "Control Area Sub-worksheet" and answer question 3a.

3a) Are the quantities of hazardous materials provided within column 6 of the Control Area Sub-worksheet greater than the quantities permitted in Tables 307.1(1) or 307.7(2) shown in column 7 of the Control Area Sub-worksheet? \_\_\_\_\_ (YES, NO OR N/A)

4) "Control Area Table" is completed and attached? \_\_\_\_\_ (YES or NO)

5) "Control Area Sub-worksheet" is completed and attached? \_\_\_\_\_ (YES or NO)



## **INSTRUCTIONS FOR CONTROL AREA WORKSHEET:**

There are several factors that need to be taken into account to determine whether a building or portion thereof is required to be classified as a Group H occupancy.

**Question 1** is basic information that must be provided for each building to determine if any hazardous materials are stored or used within the building. It is recommended that Tables 307.1(1) and 307.1(2) in the IBC be referenced to determine if any of the materials within the tables are present in the building. **PLEASE BE FOREWARNED THAT FAILURE TO CORRECTLY IDENTIFY THE MATERIALS TO THE PLAN EXAMINER AT THE TIME OF REVIEW AND APPROVAL OF THE BUILDING PLANS COULD RESULT IN CODE VIOLATIONS AT A LATER STAGE IN THE CONSTRUCTION PROCESS AND ALSO POSSIBLY RESULTING IN DESIGN MODIFICATIONS BEING REQUIRED.** The plan examiner can only base their review on the information presented to them at the time of plan review. Generally cost of design modification is less, the earlier it is done in the design process.

*If a "NO" response is provided for question 1 there is no need to complete the remainder of this worksheet. The remainder of this worksheet deals with the presence of hazardous materials within the building.*

*If a "YES" response is provided to question 1 then proceed to question 2.*

**Question 2** provides information on how the building will be designed. It was established from question 1 and the Materials Table that hazardous materials will be present in the building.

*If a "NO" response is provided for question 2 then the remainder of the worksheet must be completed starting with question 3.*

*If a "YES" response is provided to question 2 then a response is required for question 2a, completion of the "Control Area Sub-worksheet" must be provided in order to properly determine the type of hazardous materials present and the amounts of hazardous materials in storage, used in closed systems and used in open systems. A "YES" response to question 2a means that the building must be designed to comply with all requirements of section 415 of the IBC.*

*A "NO" response to question 2a means that the building may be designed to comply with all requirements of section 414 **OR** 415 of the IBC.*

**Question 3** provides additional information as to how the building will be designed.

*If a "YES" response is provided to question 3 then the control area table and the remainder of the worksheet must be completed.*

*If a "NO" is provided to question 3 then a response to question 3a is required.*

A "YES" response to question 3a means that the building must be designed to comply with all requirements of section 415 of the IBC.

A "NO" response to question 3a means that the building may be designed to comply with all requirements of section 414 OR 415 of the IBC.

**Questions 4 and 5** provide information on what additional tables and worksheets are included with this worksheet.

The following table is a portion of the "Control Area Table":

**CONTROL AREA TABLE:**

Floor level above or below grade in which material is stored or used	Number of control areas per floor	Permitted number of control areas per floor (from Table 414.2.2)	Fire resistive rating of fire barriers used to define control areas	Required fire resistive ratings for fire barriers (from Table 414.2.2)	Hazardous materials on floor level	Permitted % of the maximum allowable quantity of material per control area from Table 414.2.2

Column one of the Control Area Table provides information on the floor level location of where the hazardous material is stored or is being used. The values entered in the cells of this column are the floor levels above or below grade as applicable in which the hazardous materials are located. Each floor level that has hazardous material located on such must be indicated in this column as a separate entry.

The second column in the Control Area Table is titled "Number of control areas per floor" and provides the information on the number of control areas provided on the applicable floor.

The information required in column three titled "Permitted number of control areas per floor" is obtained directly from Table 414.2.2 of the IBC. The value provided in column two should not be greater than the value provided within column three. If the value in column two is greater than the value in column three then the building must be designed to comply with all requirements of section 415 of the IBC or the control areas need to be redesigned.

The fourth column of the Control Area Table provides information on the fire resistive rating of the fire barriers used to define the control areas. Control areas are encapsulated by fire resistive rated fire barriers. When the fire resistive ratings of the vertical assemblies differ from the fire resistive ratings of the horizontal assemblies, the lower of the fire resistive ratings should be entered within the table.

The information required in column five is obtained directly from Table 414.2.2 of the IBC. The value within column four should not be less than the value provided within column five. If the value in column four is less than the value in column five, then the building must be designed to comply with all requirements of section 415 of the IBC or the fire resistive ratings of the control areas need to be redesigned.

The information in column six is the list of all hazardous materials in each control area for the designated floor level, may be multiple materials.

The information required in column seven is obtained directly from Table 414.2.2 of the IBC. The values within column seven also have to be provided in column nine of the "Control Area Sub-worksheet".



**INSTRUCTIONS FOR  
CONTROL AREA SUB-WORKSHEET:**

The control area sub-worksheet provides information on each individual control area. The following table is a portion of the control area sub-worksheet table:

**CONTROL AREA SUB-WORKSHEET:**

Designation of control area (floor level & location on floor)	Materials located within control area	Amount of materials in storage (gallons, pounds, & gas)	Amount of materials used in closed systems (gallons, pounds, & gas)	Amount used in open systems (gallons, pounds, & gas)	Total of each material stored or used in designated control area	Maximum amount of materials permitted (from Tables 307.1(1) and 307.1(2) of the IBC)	Actual % of the materials within the control area (column 6 divided by column 7)	Permitted % of the maximum allowable quantity of material per control area (same as column 7 of Control Area Table)

The first column in the Control Area Sub-worksheet provides information on the location and designation of the control areas within the building. The entries in this column should include the floor level and a designation for all of the control areas on the floor and in the building. All control areas for the project must be accounted for in this column.

The second column within the sub-worksheet table provides information on the materials that are located within the building and each of the control areas. Building owner in consultation with building designer will need to identify what materials will be in the building. Controlled materials are obtained directly from Tables 307.1(1) and 307.1(2) of the IBC. Please note that only the materials present in the building for storage or for use must be entered in the Table.

The third column in the Sub-worksheet table titled “Amount of Material in Storage” provides information on the actual amount of the hazardous material that is in storage.

The fourth column in the Sub-worksheet table titled “Amount of Materials Used in Closed Systems” provides information on the actual amount of the hazardous material that is used in a closed system. A closed system is defined in section 307.2 of the IBC as the use of a hazardous material involving a closed vessel or system that remains closed during normal operations. The vapors emitted by the product are not liberated outside of the vessel or system and the product is not exposed to the atmosphere during normal operations.



The fifth column in the Sub-worksheet table titled “Amount of Material Used in Open Systems” provides information on the actual amount of the hazardous material that is used in an open system. An open system is defined in section 307.2 of the IBC as the use of a hazardous material involving a vessel or system that is continuously open to the atmosphere during normal operations. The vapors emitted by the product are liberated outside of the vessel or system or the product is exposed to the atmosphere during normal operations.

The sixth column in the Sub-worksheet table is the total amount of hazardous materials provided in the building. The values entered in the cells of this column are the sum of the values of columns 3, 4, and 5.

**Please be reminded that in addition to checking the total amount of hazardous materials within the control area, the amount of hazardous material for each use within the control area must also be checked.** This "Control Area Sub-worksheet" only looks at the combined capacity of the hazardous materials and does not do a check on the amount of hazardous materials based on the use of the materials. **The values within columns 3, 4, and 5 should be less than the associated values of Tables 307.1(1) and 307.1(2) for the hazardous materials and it's use. If any of the values within columns 3, 4 or 5 are greater than the associated values within Tables 307.1(1) or 307.1(2), the building must be designed to comply with all requirements of section 415 of the IBC or the control areas need to be redesigned.**

The information required in column seven titled "Maximum amount of materials permitted" is obtained directly from Tables 307.1(1) and 307.1(2) of the IBC. The value entered in column six must be less than the value provided in column seven. If the value in column six is greater than the value in column seven then the building/control area must be designed to comply with all requirements of section 415 of the IBC or the control areas need to be redesigned. It is important to read all of the footnotes associated with the tables in the IBC as these provide information when the tabular values can be exceeded and when additional limitations are imposed. For example, if a flammable liquid of class IA is in storage with a capacity of 20 gallons and in use in an open system with a capacity of 10 gallons, then the actual amount of materials within the control area would be 30 gallons. As per footnote b, of Table 307.1(1) the aggregate quantity of hazardous materials in utilization and storage shall not exceed the quantity listed for storage. In this example, the maximum permitted amount of material would be 30 gallons.

Column eight is the ratio, expressed as a percentage, of the actual amount of hazardous material within the control area (column 6) divided by the permitted amount of hazardous materials (column 7). The ratio should be expressed as a percentage. A percentage value must be entered in the cells of this column for each type of hazardous material provided within the control area.

Column nine is the permitted percentage of the maximum allowable quantity of hazardous materials per control area. The information required in column nine is obtained directly from the third column of Table 414.2.2 of the IBC. The percentages within column 8 should not exceed the percentages within column 9. If the percentage in column 8 is greater than the percentage in column 9, then the building must be designed to comply with the requirements of section 415 of the IBC or the control areas need to be redesigned. The information within this column is also to be provided within column seven of the Control Area Table.

## COMBUSTION AIR SIZING WORKSHEET

- 1) Is this heating appliance to be fueled by gas, liquid, or solid fuel? \_\_\_\_\_
- 2) Combustion air for this appliance is to be drawn from which of the following?  
\_\_\_\_\_ Outdoor air only.  
\_\_\_\_\_ Indoor air only.  
\_\_\_\_\_ Combination of indoor and outdoor air.
- 3) Rated input maximum capacity of this appliance is: \_\_\_\_\_ Btu/hour
- 4) Aggregate input of **all** appliances in the room or space is: \_\_\_\_\_ Btu/hour
- 5) Volume of the room in which this appliance is placed is: \_\_\_\_\_ cubic feet  
Length = \_\_\_\_\_ Width = \_\_\_\_\_ Height = \_\_\_\_\_
- 6) Do any exhaust systems present affect the combustion air supply? \_\_\_\_\_ (YES or NO)
- 7) Are ducts used to provide combustion air to appliances? \_\_\_\_\_ (YES or NO)  
If **YES**, are ducts horizontal or vertical? \_\_\_\_\_
- 8) List the distance down from the ceiling to top of the highest opening: \_\_\_\_\_  
List the distance up from the floor to the bottom of the lowest opening: \_\_\_\_\_
- 9) The minimum free area of combustion air opening required by my design for this appliance is: (check applicable one)  
\_\_\_\_\_ 1 square inch per 1000 Btu/hour      \_\_\_\_\_ 1 square inch per 2000 Btu/hour  
\_\_\_\_\_ 1 square inch per 2400 Btu/hour      \_\_\_\_\_ 1 square inch per 3000 Btu/hour  
\_\_\_\_\_ 1 square inch per 4000 Btu/hour      \_\_\_\_\_ 1 square inch per 5000 Btu/hour
- 10) Do louvers or grills affect the free area of ducts or openings used to supply combustion air to the appliances? \_\_\_\_\_ (YES or NO)
- 11) Appliances, except by limited exceptions, are **not permitted** to be **located in or to obtain combustion air from** the following rooms or spaces: sleeping rooms, toilet rooms, bathrooms, storage closets, and surgical rooms. Does the proposed appliance location meet this IMC 303.3 & IFGC 303.3 prohibition? \_\_\_\_\_ (YES or NO)  
If **NO**, are any exceptions of IMC or IFGC Section 303.3 met? \_\_\_\_\_ (YES or NO)

Submit all calculations of sizing of combustion air ducts or grills/louvered openings to be used.

## INSTRUCTIONS

The intent of this worksheet is to help make clear to all parties affected (owner, designer, plan examiner, and building or fire inspector) that adequate combustion air is provided. A separate worksheet may be used for each appliance or in limited cases (similar appliances), just one for all of the appliances. Note that for fireplaces the combustion air calculations may be required to be submitted with the building plan.

The first question is asked: “Is this heating appliance to be fueled by gas, liquid, or solid fuel?” This is asked to determine which Code is to be used to determine combustion air requirements for the appliance. For gas use IFGC Section 304 and for liquid or solid fuel use IMC Chapter 7 to size combustion air systems.

The second question asks from where the appliance combustion air is to be taken. This is a design decision, not a guess. The final design affects each of the remaining questions on this sheet. Department representatives could easily make a wrong assumption about the adequacy of the combustion air design when this crucial piece of information is missing. If a combination of inside and outside air is used, calculations must clearly show that a sum of the percentages of each will total to more than 100%.

The answers to questions 3 & 4 will be the same when only one appliance is in a space. When more than one appliance is located in a space, then each appliance should be investigated and the whole group must be accounted for in the design. A more complicated combustion air design occurs when there are multiple appliances of more than one fuel type located in one space. The need to answer questions 5 and 6 is more critical in any design that contains multiple appliances.

Question 5 is the volume of the room in which the appliance is placed. The IFGC does allow rooms that are open to each other to combine the volume of the two spaces, provided code requirements are met. An example when two spaces may combine their volume is when an appliance is listed for installation in an alcove (or closet) that is properly vented to the conditioned space. This condition is made clear to the plan examiner by the three dimensions listed as the second part of this question. However, any prohibitions stated in question 13 must be carefully observed as well.

Question 6 is asked to verify that there are no clothes dryers, kitchen exhaust hoods, or other such exhaust systems that will negatively affect the combustion air supply. Open combustion in negative pressure environments can lead to carbon monoxide gas produced or explosion hazards. The answer to question 8 should be **no**. Some of the areas in question 11 require the space to be a negative pressure in relation to adjacent space; thus the prohibition on their use as a location of open flame appliances is logical.

## INSTRUCTIONS (continued)

Question 7 is a two part conditional question. First you are asked if ducts are used to provide combustion air to the appliance, which is a simple **yes** or **no** response.

If the response is **no**, then move on to question 10.

But if the response is **yes**, then the second part of the question must be answered. The second part responses may be any of these three: **vertical**, or **horizontal**, or **both vertical and horizontal**. The duct direction information is needed to determine the correct formula used to calculate the duct size per IFGC 304.11.1 or IMC Chapter 7 requirement. Horizontal ducts require larger size than vertical ducts serving the same size appliances.

Question 8 asks the location of the top of the highest opening relative to the ceiling. Then it asks the distance from the bottom of the lowest opening relative to the floor. Usually there are two openings required for combustion air design per IMC Chapter 7 and IFGC Section 304.5.3.1 & 304.6.1. But IFGC Section 304.6.2 does allow a method for a single opening to serve gas appliances; thus measurements would be top and bottom of the same opening listed in these two lines on this worksheet.

Question 9 asks for the combustion air sizing used. The designer must indicate the minimum free area of design combustion air required for appliance. Choices of 1 square inch per 1000, 2000, 2400, 3000, 4000, or 5000 Btu/hour may come from IMC Chapter 7 and be listed in IFGC Sections 304.5 & 304.6 & 304.7. Factors used to determine the correct rate for sizing of the opening include: the source of the air (indoors or outdoors or a combination); the use of ducts (or not); the location of the opening (vertical or horizontal); the number of openings (one or two or more); and if forced combustion air supply system is used (or not).

Question 10 asks if louvers are used on the combustion air supply openings. The answer is almost always going to be **yes**. The yes response is a reminder that combustion air sizes required by codes are a “free area” of air transfer. IFGC Section 304.10 permits the actual louver free air size to be used to size the opening, if actual size is known. If actual size is not known, then the presence of metal louvers or grills will result in a code allowance of 60% to 75% of the opening to be actual “free area”. Wood louvers will be limited by code to be 20% to 25% of the opening to be “free area”. Duct size will be affected by the type of grill or louver used at the inlet & outlet of the combustion air duct system.

Question 11 begins with the requirement found in IFGC Section 303.3 that restricts the location of gas appliances, except as permitted by limited exceptions. It then asks a simple **yes** or **no** question about the proposed appliance location. The **yes** answer, indicating that the appliances are not located in any of these prohibited locations will be the usual response. But on occasion the appliance location may cause a no response. When that happens, there are 5 exceptions of IFGC Section 303.3 or there are 3 exceptions in IMC 303.3 to permit the appliance in that location to not be a code violation. Answer **yes** if your location satisfies one of those exceptions and you may even want to note on the plans or Worksheet which of the exceptions is being met, to make it clear to the code officials. The **no** response to this second part of the question is an indication of code violation, and will require the design to be revised to either relocate the appliance or else to meet one of the listed exceptions.

Submit all calculations of sizing of combustion air ducts to be used, especially when using combinations. Also submit all calculations of sizing of combustion air opening grills or louvers to be used. Plans must indicate the type of louvers to be used and the free area of each. Submittal of the calculations and louver information will eliminate the need for any code official to try to replicate work that the designer has already done and will clearly indicate to the code official which method of combustion air design is to be

used for each appliance. The code official will then know for certain the method used, rather than possibly second-guessing a designer's proposed combustion air design method and citing it as a violation.

## OUTDOOR AIR VENTILATION WORKSHEET

ROOM OR SPACE DESIGNATION	OCCUPANCY CLASSIFICATION	FLOOR AREA (square feet)	DENSITY PERSONS/1000 SF	OCCUPANT LOAD BY CALCULATION	VENTILATION CFM NEEDED

Minimum required outdoor air ventilation for \_\_\_\_\_ air handling appliance is \_\_\_\_\_ CFM.

**INSTRUCTIONS FOR THE OUTDOOR AIR VENTILATION WORKSHEET**

This worksheet is intended for use in determining the minimum outdoor air CFM needed at each air handling unit (ventilation appliance) serving the building. Multiple worksheets should be used if there is more than one air handling unit or if more than one area is served by multiple units.

**OUTDOOR AIR VENTILATION WORKSHEET**

ROOM OR SPACE DESIGNATION	OCCUPANCY CLASSIFICATION	FLOOR AREA (square feet)	DENSITY PERSONS/1000 SF	OCCUPANT LOAD BY CALCULATION	VENTILATION CFM NEEDED

Minimum required outdoor air ventilation for \_\_\_\_\_ air handling appliance is \_\_\_\_\_ CFM.

Total sum of Column 6

In the ROOM OR SPACE DESIGNATION (first) column above, the name or number of a room or space is noted. When spaces served by one appliance have the same use, they may be designated together as one entry.

OCCUPANCY CLASSIFICATION (second) column would have an entry of what the space will be used for (i.e., the function of the space). This may be matched with the use shown in the first column of SPS Table 364.0403. Where function of the space does not match the table, then use the most similar to that actually shown in the table [per SPS 364.0403(5)(a)2.d.].

FLOOR AREA (third) column above is where an actual square foot area from the plan is entered for the location described in the first column. Correct amount of occupied room net floor area must be carefully entered for each space [“floor net area” doesn’t include unoccupied accessory areas or thickness of walls].

DENSITY (fourth) column is the number taken directly from SPS Table 364.0403 as the number of occupants per thousand square feet of net floor area. Note that by SPS 364.0403(4)(b)2. requirement, the space minimum design occupant load for HVAC is calculated by this number. Also note this density is similar to, but not always the same as, a density that is used to determine occupancy for egress design.

OCCUPANT LOAD BY CALCULATION (fifth) column above is simply the resultant of the floor area in column three divided by 1000 and multiplied by the occupant density in column four. SPS 364.0403(5)(a)2.b. does allow a reasonable different number of occupants to be determined by other means, with justification acceptable to the Department submitted with plans. Note that an area not covered by Table 364.0403 may use the actual number of persons in a space [SPS 364.0403(5)(a)2.c.].

VENTILATION CFM NEEDED (sixth) column above is simply the resultant of the fifth column multiplied by 7.5 CFM per person. The totals in this column are then added and the sum is placed into the total line shown below the table. That total is the appliance minimum outdoor air required to be provided (and equivalent amount exhausted elsewhere to balance) for plan approval. Wisconsin professionals are reminded that the judicial system will usually reference ASHRAE Standard 62 for recognized national design practice, not the Wisconsin Commercial Building Code.

NOTE: A minimum 6 air changes must simultaneously be met along with the minimum outside air requirements when there are people present. The minimum 6 air changes may be reduced via SPS Table 364.0403 if the cooling system is sized per SPS 364.0403(5)(d)2.d.

